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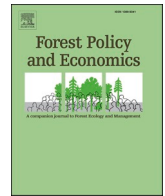
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Innovation governance in the forest sector: Reviewing concepts, trends and gaps

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ABSTRACT

Innovation in the forest sector is a growing research interest and within this field, there is a growing attention for institutional, policy and societal dimensions and particular when it comes to the question of how to support innovativeness in the sector. This Special Issue therefore focuses on governance aspects, relating to and bridging business and political-institutional-societal levels. This includes social/societal factors, goals and implications that have recently been studied under the label of social innovation. Furthermore, the emergence of bioeconomy as a paradigm and policy goal has become a driver for a variety of innovation processes on company and institutional levels. Our article provides a tentative definition of “innovation governance” and attempts a state-of-art review of innovation governance research in the forest sector. For structuring the research field, we propose to distinguish between organizational/managerial, policy or innovation studies. For the forestry sector, specifically, we suggest to distinguish between studies focusing on (i) innovative governance of forest management and forest goods and services; on (ii) the governance of innovation processes as such, or (iii) on specific (transformational) approaches that may be derived from combined goals such as innovation governance for sustainability, regional development, or a bioeconomy. Studies in the forest sector are picking up new trends from innovation research that increasingly include the role of societal changes and various stakeholders such as civil society organizations and users. They also include public-private partnership models or participatory governance. We finally should not only look in how far research approaches from outside are applied in the sector but we believe that the sector could contribute much more to our general scientific knowledge on ways for a societal transformation to sustainability.

1. Introduction – the increasing awareness of the societal dimension in innovation

Innovation is a driver of economic development and competitiveness of countries, sectors and firms (Schumpeter, 1934). For firms, innovation is necessary to adapt to changing economic and social environments, and to exploit new opportunities from emerging demands. This is also true for the forest sector, whereby global competition pressures seem to capture the attention of firms and policy makers more than emerging opportunities (Hansen et al., 2006; Kubezcko et al., 2006; Weiss, 2019).

As shown in the extensive literature review in this Special Issue

(Weiss et al., 2020), innovation in the forest sector is a growing research interest. The topic has been investigated for four decades, with the pace of research intensifying some 15 years ago. At the same time, innovation has received increasing attention from policy-makers and is now commonly included in the framing of research programmes. Innovation studies aim to understand innovation processes, their causes, influencing factors, outcomes and systemic consequences. As an example, the first article included in the mentioned literature review is titled “Important factors in the forestry innovation process” (Moeller and Shafer, 1981). Study approaches differ, with some focusing more on company innovativeness and company internal processes, such as new product development or innovation management (e.g., Wagner and

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Hansen, 2005; Nybakk, 2012; Henttonen and Lehtimäki, 2017), while others include external actors and factors, e.g., taking a systems-based approach that include the interaction among various types of actors as well as institutional factors in their analysis (Hansen et al., 2006; Rametsteiner and Weiss, 2006). They may look at spatial and/or sectoral dynamics in innovation processes (e.g., Figueiredo, 2010; Ng et al., 2012; Al, 2017; Hanna et al., 2017; Adejuwon, 2018). Others specifically focus on social factor or drivers (e.g., Dandy, 2016; Louah et al., 2017), institutional change (e.g., Tewari and Isemonger, 1998; Cortner et al., 2001; Schroth and da Mota, 2013), or the role of policy (e.g. Song et al., 1997; Gray, 2000; Snider et al., 2003; Beyers, 2002; Helynen, 2004; Šipikal, 2013; Abrams et al., 2017).

Various types of innovations have been tackled – ranging from new goods and services to process, marketing and organizational innovations and institutional and policy aspects. The role of political-institutional frameworks for innovation support are increasingly seen as being of fundamental importance. And, under the label of “social innovation”, social/societal factors, goals and implications have been added as another dimension. Global challenges such as sustainability crisis, climate change and growing global social and economic interdependencies call for transformational innovations and new forms of governance in order to adapt technologies, economies, and societies (TWI2050 - The World in 2050, 2018). Consequently, interdisciplinary views and systemic or integrated models of innovation have gained relevance. These theoretical advances are yet to be fully integrated into the analysis of the forestry sector and its idiosyncrasies.

Global economic and ecological challenges and the rising political awareness for sustainable economic growth have given new impetus for innovations in forestry/the forest sector (Pätäri et al., 2016). From a sectoral perspective, the emergence of bioeconomy as a paradigm and a highly complex policy area acts as a driver for renewal of forest sector businesses (e.g. Winkel, 2017; Lovrić et al., 2020). Such a renewal necessarily implies a variety of innovation processes, taking place within and around firms.

While the *Forest Policy and Economics* Special Issue from 2006 looked broadly at “Innovation and entrepreneurship in the forest sector”, the current Special Issue focuses on governance aspects, relating to and bridging business and policy levels as well as industry and policy spheres. Our terminology understands the “forest sector” as consisting of “forestry” (the production of forest-based goods and services, usually raw materials) and the connected industrial sectors in a range of value chains, including the more traditional pulp and paper, furniture or construction industries as well as bio-energy, emerging new bio-based products or service industries such as tourism or health services. In our understanding, these should all be seen as part of what is now discussed under the term bioeconomy (Winkel, 2017). The harvest of this call for papers is rich, with 13 articles spanning a broad spectrum of topics and approaches, including specific governance approaches (Hayter and Clapp, 2020; Purkus and Luedtke, 2020), the role of policy (Toivonen et al., 2021; Ludvig et al., 2021), companies (Poduška et al., 2020; Štěrbová et al., 2021), civil society (Lawrence et al., 2020a; Wilkes-Allemann et al., 2020), advisory systems (Kilcline in this Issue (to be finalized), 2021; Lawrence et al., 2020a), the forestry service sector (Pynnönen et al., 2021; Holopainen et al., 2020; Štěrbová et al., 2021), bioeconomy (Purkus and Luedtke, 2020; Pelai et al., 2020) and social innovation (Lawrence et al., 2020a; Ludvig et al., 2021; Wilkes-Allemann et al., 2020). It also includes a systematic literature review of 230 peer-reviewed articles on innovation in the forest sector (Weiss et al., 2020). In this introductory article, we take a broad perspective and aim to sketch the state of knowledge, research trends and gaps in the field and the contribution of these articles to the advancement of our knowledge. In view of the collected articles, we discuss the state of research along the following themes: Innovation governance, forestry, wood industry, as well as bioeconomy and social innovation as being two examples for emerging research fields.

2. Innovation governance - bridging business and policy

For decades, scholars have focused on innovation as a key factor in the creation and maintenance of firms' competitive advantage (Dam-anpour, 1991; Sinkula et al., 1997). Due to the intrinsically dynamic nature of a market economy, firms must either be engaged in a constant process of change and renewal affecting all aspects of their operations, or risk being blown away by the incessant gale of creative destruction (Schumpeter, 1934). Management must simultaneously explore new possibilities while efficiently exploiting existing opportunities (O'Reilly III and Tushman, 2013). In order to effectively tackle this ambidexterity challenge, managers must develop dynamic capabilities (Birkinshaw et al., 2016), implementing business models and practices able to effectively support both regular and innovative processes.

These considerations apply to essentially any sector, as all are affected by development; however, the idiosyncratic technological, organizational and contextual factors defining each sector play a role (Malerba, 2002). For a sufficiently broad sectorial definition, one taking also into account its supporting systems and relational networks, all aspects of innovation theory can be gainfully applied. This applies to the forest sector as well (Nybakk, 2009; Weiss, 2019). While innovation research used to focus on the firm, taking into account its processes and dilemmas, as cursorily illustrated above, scholars have increasingly taken into account the key role played by the relationships existing between firms and that vast array of social actors and institutions which both support and constrain their operations. Innovation is not merely a managerial instrument for competitive dominance, it can also be used in references to dynamics of change aimed towards achieving goals shared by a wide variety of social stakeholders; we refer to such processes as social innovation.

Social innovation denotes innovative activities aiming towards overcoming social and economic problems for the benefit of society at large (Bock, 2012; Hämäläinen and Heiskala, 2007; Murray et al., 2010; Phills et al., 2008). As a direct consequence of its definition, social innovation governance necessarily involves a variety of actors (Grimm et al., 2013), participatory governance tools (Moulaert et al., 2017), and less orientation towards merely economic and single firm-profits (Jacobi et al., 2017) with more focus on regional economic and/or societal benefits (Sinclair and Baglioni, 2014). In the forest sector, social innovation (Rogelja et al., 2018; Nijnik et al., 2018) or inclusive innovation (Refsgaard et al., 2017) is a new field of research since a couple of years. Social factors in innovation more broadly have been studied in the form of social practice (Dandy, 2016), cognitive barriers (Louah et al., 2017), gender differences (e.g., Villamor et al., 2014) or institutional change in various cultural contexts (e.g., Zhang and Putzel, 2016; Minang et al., 2019).

Studies of innovations for sustainability often focus on transformative innovations supporting the change of our economic (or social) system, e.g., towards a bioeconomy, whereby differing understandings of sustainability or bioeconomy are observed (Bugge et al., 2016; Hausknost et al., 2017).

Innovation entails the generation of new knowledge, which partially adds to and partially contradicts what is already known (Antonelli, 1999). This process necessarily takes place at the system-level, as the socio-economic context of reference reacts and interacts with the knowledge embodied in the new process being implemented (Teece, 1989). The consequences of innovation are therefore unbounded and uncertain, as the systemic nature of the ensuing adaptation process can lead to cascading effects operating on levels quite far from the immediate context of the process. To understand such effects, and the related influence of the system on the innovation process, a rich literature on innovation systems has developed.

The literature on systems of innovation (Freeman, 1987; Lundvall, 1992; Nelson, 1993) describes organizations and institutions in constant interaction, resulting in a dynamic and generative set of relationships through which the system fulfills functions in the innovation process, e.

g., providing information and incentives or coordinating the involved actors (Edquist, 1997). Firms do not innovate in isolation; innovations are based on interactive learning, leading to subsequent feedback effects involving the entire relevant innovation system. In fact, it is this complex iterative process that defines the system itself, whose boundaries are constantly renegotiated according to the evolutionary pattern of innovation processes. The complexity involved in such processes illustrates why innovation governance cannot be reduced to policy development and implementation. Policy is just another component of the broader innovation system, interacting with various organizations and institutions, and potentially leading to outcomes far from original plans. Any policy-maker dealing with innovation must know that the uncertainties involved in the process make reactive, adaptive and creative capabilities crucial for navigating the non-linear process of innovation (Kline and Rosenberg, 1986).

Depending on study contexts, innovation governance has been defined differently. Generally, we consider innovation governance to be the way how innovation and related knowledge processes and implementation measures are explicitly and implicitly, formally and informally arranged within an organization, network or governmental system, with including all formal and informal external relations. It thus relates to corporate, sector or public governance of innovation processes.

Governance as a concept is often used in studies that go beyond firm-level approaches to innovation (e.g., new product development or innovation management). How governance is understood differs as they may look at governance within organizations, industrial sectors or the state. The theories are thus rooted in management, innovation or policy studies. For the innovation studies, the following are some of the more often applied conceptual approaches. They are often used as both analytical models as well as normative models for innovation governance.

The core elements in an innovation system (or, innovation ecosystem, Adner, 2006) are i) the firms and other economic actors, ii) research and education organizations and iii) political-institutional actors, consolidated in the triple helix model (Leydesdorff and Etzkowitz, 1998) as industry, university and government. Other approaches have explicitly added the users of innovative products and services, or the society as elements of similar importance, referred to as the quadruple helix (Carayannis and Campbell, 2009), socio-technical systems (Geels, 2004; Rohracher, 2001), user-centered innovation (von Hippel, 2005), open innovation (Chesbrough, 2003), value-based approaches (Vargo and Lusch, 2004) or social innovation (Moulaert, 2013).

The analysis approaches taken by the studies in our Special Issue, are manifold. One article undertakes a comprehensive systemic analysis by addressing the whole innovation system in the sector, namely Canada's forest sector research, development and innovation system, and including its historical development (Hayter and Clapp, 2020). The analysis of biotechnology governance in the US frames the system for the development and implementation of biotechnology innovations as a sector-related governance system (Pelai et al., 2020).

Other articles put the role of policy more in the center of the analysis, e.g., the current governance system for the forest-based bioeconomy in Germany (Purkus and Luedtke, 2020). The study of the governance of multi-storey wood construction in Finland specifically analyses the related and competing policy narratives (Toivonen et al., 2021). The study of the role of policy for social innovation in forestry in Europe looks at mutual relationships between policies and social innovations (Ludvig et al., 2021).

Many studies focus on the roles of specific actors in the governance of innovation, including public (policy), private (industry) and civil society (third sector) actors. In the Special Issue, public forest enterprises are studied in Serbia, with regard to internal innovation processes (Poduška et al., 2020). Private enterprises are in the centre of the study of forest service operators in Slovakia (Štěrbová et al., 2021). Civil society actors played a central role in the development of mountain bike trails, for

instance, in Austria and Switzerland (Wilkes-Allemann et al., 2020) and similarly for the provision of various woodland products and social services in the UK (Lawrence et al., 2020a).

Advisory systems are of central importance in any innovation support but particularly in forestry with fragmented ownership structures since owners of small properties or enterprises often lack innovation capacities. Advisory systems are in the focus of the studies of wood mobilisation in Ireland (Kilcline in this Issue (to be finalized), 2021) and woodland social enterprises in the UK (Lawrence et al., 2020a). Some of our studies look at innovation governance processes around specific services, including a Finnish state-funded digital information platform for (small-scale) forest owners (Pynnönen et al., 2021), and a business oriented forest management service in virtual reality (Holopainen et al., 2020).

Although having specific actors in the center of their studies, all are aware of and emphasize complex relationships among multiple actors which are conceptually and empirically considered in their analyses. In most articles, relations among various types of public and private actors within systems or networks are analysed or specific customer relationships or user-orientation. Those studies focused on company innovativeness included business environment as a factor for intrapreneurial climate and employee innovativeness (Poduška et al., 2020), or the influence of societal trends such as environmental awareness as a factor for eco-innovations (Štěrbová et al., 2021).

3. Forestry and innovation - when all foresters are thinking alike, then no one is thinking?

Innovation in forestry has long been a vibrant research area. Although there is a tendency for classical innovation topics of timber-oriented forestry innovation to appear in forestry journals, with other journals focusing on broader research questions such as rural or regional development or transformation (e.g., Tödting and Sedlacek, 1997) or the perception and effects of industrialization (e.g., MacDonald and Clow, 1999; Shiro et al., 2007; Birch et al., 2010), the divide is not that pronounced. Indeed, innovation research within the forest research community was interested from the beginning not only in timber production but also in other forestry activities and the societal benefits of forests (Weiss et al., 2020). Similarly, systemic approaches and questions of innovation governance have always received strong interest. Most studies draw connections to system relationships (e.g., Globerman et al., 1998), the role of policy (e.g., Cortner et al., 2001; Rametsteiner and Weiss 2006; Innes, 2009) and broader societal impacts (Spilsbury and Kaimowitz, 2002), in both industrialised and developing countries (e.g., Segura-Bonilla, 2003; Klooster, 2002). A range of studies analyse regionally focused innovation governance such as the support of clusters or similar models (Tödting and Sedlacek, 1997; Šipikal, 2013; Dayneko and Gustafson, 2014; Bayne et al., 2016).

Innovation research shows that, as a mature sector, forestry (and the forest industry alike) tend to focus more on process rather than product innovation, a fact regarded as a weakness in a moment when society requires new goods and services, such as ecological and cultural services and non-timber products (Weiss, 2019). In general, structural problems, such as fragmented property rights among owners for whom forests are not a primary economic interest, have resulted in a weak innovation orientation, although larger forest holdings are as innovative as other primary or low-tech sectors. Furthermore, we still observe gaps and weaknesses in the institutional support system for sectorial innovation. The focus of companies and innovation systems on the rationalisation of roundwood production, although valuable, have led to more ambitious business opportunities being missed (Rametsteiner and Weiss 2006). In many countries, forest policies feature limited innovation support, with forest sectoral innovation systems being often poorly connected to national innovation systems and other highly innovative sectors, such as bio-based products or forest ecosystem service markets (Rametsteiner and Weiss 2006; Weiss et al., 2011a). Forestry innovation systems have

been characterised as closed circles of actors with a strong forest-related identity and strong relations among themselves but less openness and poor interrelations with other sectors (Rametsteiner and Weiss 2006). Although the strong internal relations have supportive effects on the traditional activities, this hinders any rejuvenation or extension dynamics in the sector (Levitt, 1965). It reinforces the concentration on traditional products which is characteristic for mature sectors, but is a barrier for developing new business fields (Kubeczko et al., 2006; Butoud et al., 2011; Weiss et al., 2017a). A comparative analysis of regional forest industry clusters from various European countries concludes that cross-sectoral openness is a prerequisite for innovative performance of those clusters (Weiss et al., 2017b).

Within the field of innovation governance in forestry we may distinguish between (i) innovative governance of forest management and forest goods and services and (ii) the governance of innovation processes. A specific need for governance innovations in forestry as being addressed in the first field (i) follows from the fact that forests have multiple market and non-market benefits and many of their goods and services have public good characteristics (Slee, 2011; Weiss et al., 2011b). Those goods and services pose a specific challenge for their provision, including market, policy and community approaches or mechanisms (Ostrom, 1990). Therefore, possibilities of market or business innovations are limited and social, institutional or policy innovations are required in particular. That is also shown in context of the “payments for ecosystem services” approach (PES, Snider et al., 2003; Bishop et al., 2009; Wunder and Wertz-Kanounnikoff, 2009). The specific management, economic and institutional qualities and implications of different forest ecosystem services (Millennium Ecosystem Assessment, 2005) are demonstrated in research particularly around non-wood goods and services. Those have since long been the focus of extensive research and advisory work in a developing economies' context (e.g., MacQueen et al., 2018; FAO, 2017) and has recently been studied in larger European projects (Lovric et al., 2020; Vacik et al., 2020; Wolfslehner et al., 2018). In our Special Issue those articles dealing with social innovations are specifically related to the institutional difficulties connected with many of those ecosystem services (Lawrence et al., 2020a; Ludvig et al., 2021; Wilkes-Allemann et al., 2020).

With regard to the second field (ii), the study of innovation systems has been and still is a prominent approach, as illustrated by the number of articles of this Special Issue making use of it. The relevant sectoral (or technological) innovation systems are not always or solely described on national levels; regional level (sectoral or non-sectoral) innovation systems are often more directly relevant for actual innovation activities, although they still remain embedded in larger systems in various ways (Weiss et al., 2017b). As shown in our Special Issue, studies may relate to the full scope of the connected forest-based industries, as illustrated by the analysis of Canada's forest sector innovation system (Hayter and Clapp, 2020). Other articles have a purposive stronger focus on forestry within the larger sector (Kilcline in this Issue (to be finalized), 2021) or take a targeted perspective, e.g., the Slovakian forestry service sector (Štěrbová et al., 2021). Others focus on new ways through which a system can emerge, e.g., the German forest bioeconomy (Purkus and Luedtke, 2020) and the technological innovation system around multi-storey wood construction in Finland (Toivonen et al., 2021). Those studies illustrate how the innovation systems approach can provide a useful and flexible heuristic framework for studying innovation processes as well as their governance throughout distinct research contexts and for varying research questions.

A question rarely dealt with in innovation studies are the characteristics of public and private forest ownership, and the specific environments and determinants for innovating in public as opposed to private forest holdings (Niskanen et al., 2007; Teder et al., 2015). The Special Issue's contribution on “intrapreneurial climate” as an innovation factor in public forest enterprises (Poduška et al., 2020) advances our knowledge in this field and on the role of organizational culture and

company climate (Hansen et al., 2014). According to this case study of four Serbian state companies, employees' innovativeness is positively influenced by entrepreneurial attitudes, good managerial support, a purposeful reward system and work autonomy. The state as an innovative service provider is studied on the example of a Finnish e-information service for forest owners (Pynnönen et al., 2021).

In the following, we discuss the state of art with regard to two very central dimensions of innovation processes, information (with a specific view on the role of research), and interrelations of actors (particularly related to the cooperation of forest owners and cooperation between public and private actors). Both aspects together become relevant in the analysis of services. While innovation studies and innovation support initially focused on research and development, the systems approach has promoted a broader perspective. Research is now understood not as the single driver of innovation, but rather as a necessary resource, with strong complementarities (Lovrić et al., 2020). For instance, the analysis of the Canadian Forest Sector Innovation System asks how the organization of research and development is presently organised as a result of a complex evolution through time, showcasing an interesting example of a new governance approach involving both public and private sectors (Hayter and Clapp, 2020). The analyses of barriers for the use of biotechnology in forestry (Pelai et al., 2020) illustrates how the sector has its research activities embedded in society and cannot act independently from public perceptions. This review article on biotechnology concludes that, for a constructive policy approach, inclusive governance mechanisms are needed to build trust in institutions. In a study applying Design Science Research Methodology for developing virtual reality forest management services in the Nordic region (Holopainen et al., 2020), a user-centred innovation approach is presented where the inclusion of potential customers should maximise the user orientation of new services. All those three studies conceptualise research within a complex mutual relationship between the sector, research and society, stakeholders and users.

To tackle one of the main structural problems of forestry, ownership fragmentation, policy makers have increasingly promoted cooperation among owners (Mendes et al., 2006; Glück et al., 2010). Among the multiple approaches with different aims, forms and models of cooperation, some have focused more on the mutual benefits of operational cooperation in forest management (Kittredge, 2005), others on joint interest representation in policy processes (Sarvasova et al., 2015). A study of wood mobilisation in Ireland finds that rigid institutional structures and weak networks hinder capacity development of forest owners, with the effect being especially pronounced for new forest owners (Kilcline in this Issue (to be finalized), 2021). The study applied an innovation systems framework that integrates structural and functional aspects of innovation systems to identify systemic problems that hinder the functioning of the forest sector innovation system, eventually compromising potentials for co-innovation and wood mobilisation. The study also contributes to the growing research on evolving forest ownership structures, including the increasing share of non-traditional, non-farm, absentee or urban owners lacking knowledge, skills and capacities in forest management (Weiss et al., 2019; Lawrence, 2019). The Finnish governmental digital forest information platform *Metsaan.fi* is another attempt to support small forest owners in forest management (Pynnönen et al., 2021).

Cooperation among different types of public and private actors is a central feature in systems of innovation research approaches. The central importance of multi-actor collaboration is highlighted in this Special Issue by the analysis of current public-private partnership approaches in the context of Canadian forest sector research and development (Hayter and Clapp, 2020) and the German “Charter for Wood 2.0”, an ongoing participatory governance process for developing the forest-based bioeconomy (Purkus and Luedtke, 2020). Collaboration among different types of societal actors is also a characterising feature of any social innovation, including civil society actors, illustrated in this Special Issue by a number of contributions (Lawrence et al., 2020a; Wilkes-Allemann

et al., 2020; Ludvig et al., 2021).

The forestry service sector (Mattila et al., 2013; Näyhä et al., 2015; Pelli et al., 2017) has gained attention in recent research, studying advisory services (Lawrence et al., 2020b) and forest operations as part of the production system (Bouriaud et al., 2011). There are many types of service providers, particularly at the institutional level, with important innovation supporting roles/functions, for instance providing information and facilitating collaboration among the innovation system actors (Rametsteiner and Weiss 2006; Ludvig et al., 2016). In our Special Issue, we find examples where – although not being typical extension organizations – state agencies provide information and support to forest owners. In Finland, the state forest authorities provide private forest owners with information about their forest land through an internet-based forest information and e-government service (Metsaan.fi), supporting forest management decision-making (Pynnönen et al., 2021). This article sheds light on how forest owners can be engaged through internet-based information services and highlights the importance of attitudinal patterns of intended users for the success of such services. The study illustrates the combination of innovation and service research theories as being a fruitful and promising research direction. Commercial examples comprise the Finnish high-tech case of developing virtual reality forest management services (Holopainen et al., 2020) and forest harvesting in Slovakia (Štěrbová et al., 2021). For the development of the Finnish virtual reality service, design science research methodology was applied which puts an active emphasis on the users' preferences. This study also shows how important the inclusion of potential users is in innovation development and gives a concrete example for an appropriate method. In the case of forest contractors in Slovakia, the greatest challenge lies in limited financial capabilities of micro-firms facing strong competition, a situation where the key factors supporting innovation – and even more so environmentally-oriented innovation – are regulatory policy instruments, financial support and demand-side pressure for modern and environmentally-friendly technologies. This study also confirms the strong role of societal change and social factors in general, such as environmental awareness of both innovators as well as clients.

4. The wood industry – more innovation “wood” be good!

Seeing the forest sector as traditional and slow to innovate, the academy slowly began to embrace innovation research in the forest sector only in the 1980s (Weiss et al., 2020). Early industry-related work typically focused on adoption of products in the marketplace or adoption of technology by manufacturers of forest products. The early 2000s, saw a steady stream of work depicting the innovativeness of forest sector firms. For example, Välimäki et al. (2004) identified a connection between innovativeness of Finnish companies and profitability, supporting that generally accepted premise. The mid-2000s saw increased work on new product development in the industry with research coming from Australia, Sweden and the US. The general focus on innovativeness continues well into the 2010s. A 2006 Special Issue of *Forest Policy and Economics* brought increased emphasis to research based on innovation systems. In the literature summarized by Weiss et al. (2020), firm capabilities are addressed for the first time in 2009 and only five times total. Given the relevance of dynamic capabilities in business literature, this low level of coverage is somewhat surprising.

Two articles in our Special Issue focus primarily on the industry (Hayter and Clapp, 2020; Toivonen et al., 2021), with other articles addressing aspects pertinent to industry as part of other pursuits. As an example, intrapreneurial climate (Poduška et al., 2020) is relevant to all forest sector firms. Similarly, the historical perspective in Weiss et al. (2020) reviews work relevant for the entire forest industry.

In the latest innovation-focused Special Issue of *Forest Policy and Economics*, Van Horne et al. (2006) provided an overview of centres of expertise in the Canadian innovation system, including Forintek, the country's forest products research and development laboratory. As with

many other national forest research institutes (for example, in Finland), Forintek was merged with two other institutes to form present day FPInnovations. Using an innovation systems lens, Hayter and Clapp (2020) provide a detailed description of the process and outcomes of that merger which formed a public-private partnership. A particularly important aspect of this documentation captures the reactive nature of innovation work in the sector, the fact that it was largely focused on improved efficiencies and reactionary to competition, and that in-house R&D of Canadian companies collapsed in the 1990s. This reactive approach has been described as an ad hoc response to customer comments (Hansen and Breede, 2016). The collapse of firm R&D happened in other countries as well (e.g., the US; McGinley et al., 2019), to the point that few forest sector companies maintain true R&D facilities. Demise of in-house R&D not only eliminated the obvious physical capacity to innovate, but the loss of intellectual capacity within the companies also translated to a loss of the, “...richness of technological liaisons in the R&D system as a whole” (Hayter and Clapp, 2020, p. 113). In other words, loss of intellectual capacity means that the ability to effectively interact with universities, research institutes, and technology suppliers is diminished. For the innovation system in Canada, these changes have pushed FPInnovations to expand its work and collaborations outside of Canada and to increasingly rely on patents and licensing as part of its business model. The authors conclude that industry is often ill-prepared to interact with and benefit from the expertise resident at FPInnovations and policies to increase the absorptive capacity within forest industry companies may be an apt tactic for improving innovation within the system. Similarly, McGinley et al. (2019) lament the shrinking forest sector scientific expertise in the US.

The characterization of wooden multi-storey construction in Finland by Toivonen et al. (2021) well describes the difficult path innovations face in diffusing into the market, as various incumbent actors work actively against the innovation. For example, an effort in the state of Oregon in the US to emulate the Wood First program in British Columbia Canada was squelched by the cement lobby. Similar lobbying has occurred in Europe related to multifunctional forestry (Buttoud et al., 2011) or wood construction (Ludvig and Weiss, 2013). So too in Finland, existing firms vested in traditional concrete construction are reticent to see wood-based construction succeed in the market. One of four policy narratives outlined by Toivonen et al. (2021), the counter narrative, describes efforts against development of wood construction in Finland. Each of the remaining three policy narratives in Toivonen et al. (2021) are pro-wood. The bioeconomy narrative sees wood construction as a fundamental aspect of the bioeconomy in Finland, based on sustainable forestry and rational use of forest resources. The wood industry narrative emphasizes use of wood in urban building to create demand for value-added wood products. Included in this narrative are consideration of the barriers to increased wood construction, including a conservative construction sector and lobbying from other material sectors. Finally, the climate change narrative focuses on transforming the construction sector to a provider of a climate-smart, low-carbon built environment, including an association with circularity. Throughout the descriptions of the narratives is embedded important insights on the changes and adaptations necessary for more effective adoption of multi-storey wood construction. Examples include active network creation (Toppinen et al., 2019), role of intermediaries (Vihemäki et al., 2020), cultural background for building with wood (Høibo et al., 2018), and the role of different policy measures (Vihemäki et al., 2019), among others.

Despite extensive existing work and the passing of decades, even the most current work continues to describe forest sector firms using terms such as traditional, mature, and low-cost focused. Now the sector is faced with a fundamental shift in markets and business models manifested as the bioeconomy era. In other words, of any era of the modern forest sector, now is the time for the industry to be innovative in order to survive the transition to a bioeconomy. While the volume of innovation focused research has clearly increased in the last several decades (Weiss et al., 2020), we have very little understanding of whether this is

effectively informing and impacting innovation within forest sector firms. Is this flood of academic research contributing to genuine change in real-world practice? With this in mind, there is continued need to understand current strategies and operations of forest sector firms.

In the vast catalogue of work documented by Weiss et al. (2020), only two articles expressly address moderation or mediation in their titles (Han et al., 2013; Nybakk et al., 2011). While there may well have been other examples of attempts to assess moderators and mediators among constructs in existing work, this suggests that it is not especially common and opens the door for new research designed to better understand the complex dynamics of, for example, what makes one company more innovative than another, and what array of resources and capabilities may provide the biggest payoff with respect to firm performance.

There has been a strong call for forest sector firms to embrace collaboration outside the sector in order to develop radical innovations well-suited for bioeconomy markets. It may be that forest sector firms need this to make a successful transition to the bioeconomy. Given that there is no strong history of collaboration with other sectors by forest sector firms, this presents a significant opportunity for research that can help firms develop this transitional capability (e.g., Näyhä, 2020).

5. Emerging topics – bioeconomy and social innovation

We have the last years seen several new emerging topics in the forest journals (Weiss et al., 2020). One of them is social innovation which appeared first in 2018 and which is also highly visible within this Special Issue, with three papers dealing with governance aspects of social innovation such as advisory services (Lawrence et al., 2020a), the impacts of policies (Ludvig et al., 2021) and the specific roles of civil society actors (Wilkes-Allemann et al., 2020).

Furthermore, the interest in the forest sector transitioning to a bioeconomy has created a significant wave of innovation research. The first article analysed by Weiss et al. (2020) to have “bioeconomy” in the title was in 2010 (Birch et al., 2010), but by 2018 there were a total of seven, with one in four innovation related articles in that year addressing some aspect of the bioeconomy. Due to the key role of wood in the bioeconomy, multiple articles also appeared in recent years, in particular related to the building sector, one of the sectors with the strongest ecological footprint and thus greatest potential for reducing climate impacts.

5.1. Bioeconomy - something new, or only the new buzz word?

Global megatrends, including climate change, resource scarcity, demographic and social changes, urbanization, and technological breakthroughs are drastically shaping business and society now and will continue to do so in the future. Originally, the term bioeconomy can be traced to “bioeconomics” introduced by Georgescu-Roegen (1971), while its current connotation is driven by policymakers (Vivien et al., 2019). The primary productive sectors (forestry, agriculture and fisheries) play a fundamental role in the bioeconomy, although interpretations of the concept vary with some more focused on biotechnologies. In a bioeconomy, industrial inputs (e.g., materials, chemicals, energy) are substituted by or complemented with renewable biological resources, aiming at lower environmental impacts compared to use of non-renewables (Bugge et al., 2016). However, according to, for example, Hurmekoski et al. (2019), the forest-based bioeconomy in Europe is still perceived to be a visionary future rather than a phenomenon addressing real-world challenges in the contemporary forest sector.

To accelerate national-level bioeconomy development, the European Union (EU) Bioeconomy Strategy was recently updated (European Commission, 2018), and now places more emphasis on sustainability aspects and the potential contribution of bioeconomy to, for example, the UN Agenda 2030. Expansion of the forest-based bioeconomy must

negotiate among multiple demands on forests, and in the recent years, we can notice a growing emphasis on bioeconomy activities relying on forest-based services, for instance, nature-based tourism, so no longer reflecting an exclusively industry-driven and material-based view.

Circular economy is another prominent policy concept for shaping future development of the forest-based sector. In the future, circular and bioeconomy will become increasingly intertwined (see a recent Special Issue in Forest Policy and Economics from 2020 edited by Dalia D'Amato, Tobias Stern and Anne Toppinen), and forest-based industrial renewal towards more ambitious circularity is to be expected (e.g., Temmes and Peck, 2020; Ladu et al., 2020). This gives impetus to further research on the innovative use of side streams, and how to better extract higher value added from them. From a bioeconomy innovation perspective, Toppinen et al. (2017) advocated that more attention must be placed on customer value-added and collaboration of forest-based industry with other sectors in research, development and innovation activities. Prime examples of these include those that are facing increasing pressure to detach from oil, including energy, chemicals, textiles and concrete or steel-based construction solutions.

Similar to sustainability, the bioeconomy is strongly impacted by political goals, discourses, interests and power. Comprehensive understanding of sectoral changes and innovations therefore need to include broader conceptualisations of market processes and value such as its co-creation by multiple market actors (Vargo and Lusch, 2004; Hujala et al., 2019), social political discourses such as how bio-economy is framed (Hausknot et al., 2017) and political-economic processes such as financialization, capitalization and assetization (Birch, 2017). Bioeconomy related articles in our collection do that in very different ways.

In this Special Issue, Purkus and Luedtke (2020) applied an innovation system analysis which provided a framework for examining complex cause-effect relationships within the German Charter for Wood 2.0, drawing from the German bioeconomy strategy. They found that adopting a utilization-focused participatory approach to be effective, but it must not lead to a disregard for perspectives of less salient and perhaps more marginal stakeholders. Pelai et al. (2020) compose a systematic review of governance barriers when it comes to the utilization of biotechnology faced by agriculture and forestry, finding relatively greater emphasis in the forestry literature on regulatory and legal barriers. Their review also reveals that fewer forestry articles are informed by insights from the social sciences and humanities compared with those in agriculture. Applying biotechnology in the forest and agricultural sectors calls for acquiring better understanding of how different justifications for adopting biotechnologies in the scientific literature may be translated into public policy. In practical terms the questions include how to involve relevant stakeholders, rights holders and different publics at the earliest possible stage of policy implementation to ensure better management of biotechnology related risks. Toivonen et al. (2021) show how different sector interests form policy narratives on the use of wood in construction.

Since, in a broad and inclusive understanding of bioeconomy, practically all forest sector activities have a direct relevance, we could file all articles under “bioeconomy”. More useful, however, is to refer to the concept when the specific aspects are studied that are relevant for a transition of the sector. When looking at the literature review that is part of this Special Issue (Weiss et al., 2020), it seems this is done by those 13 studies that prominently use this keyword in the titles and abstracts and those studies provide highly interesting new insights into the current sectoral changes and challenges.

5.2. Social innovation – being good and having an impact?

Recent forest sector research has shown that social innovation can be a useful tool for local and regional economic development, bringing advantages for manifold activities in the service-based forest sector (Nijnik et al., 2018; Ludvig et al., 2018a, 2018b; Melnykovich et al., 2018; Rogelja et al., 2018; Hewitt et al., 2019; Sarkki et al., 2019;

Zivojinovic et al., 2019). Social innovation embraces all types of innovation with strong civil society participation, the use of inclusive participatory tools and the (normative) goal of collective benefits in its outcome. From a governance perspective this includes non-hierarchical processes of governing, in which non-state, private corporate and civil society actors participate in and contribute to the formulation of public policy (Ostrom, 1990; Mayntz, 1998; Rhodes, 1997).

In our Special Issue, this situation is found in the case of developing mountain bike trails in Austria and Switzerland which have social innovation characteristics as they were initiated by civil society actors to cater to a new social demand (Wilkes-Allemann et al., 2020). This study specifically analysed the interactions among a range of diverse public and private actors and found unexpected complexity in the conflict resolution processes, profound institutional and organizational changes, and that the institutional arrangements around the trails are still subject to further change. Public policies and public actors may support or may hinder social innovation, as a further contribution to this Special Issue on policy impacts shows (Ludvig et al., 2021). Examining the influence of public policies on various cases of social innovation throughout Europe, the authors show how the inherent “top-down” logic of public subsidies can bring harmful effects. Additionally, social innovation initiatives may be perceived as too critical towards existing public institutions, appearing as a threat to neutralize rather than support. The article identifies policies that affect social innovation positively and negatively, but it also identifies social innovation initiatives that have affected the formulation of new policies. The third contribution on the topic of governance and social innovation (Lawrence et al., 2020a) focuses on analysing cases of support of social innovation in woodlands, coming to a similarly mixed diagnosis. While policy-based interventions based on cross-sectoral partnership helped woodland social enterprises to develop and function, the rearrangement of actors' constellations into a participatory peer-to-peer network failed. We may conclude that state actors can have a very supportive role in providing capacities to local actors to develop social services, however, they hardly support more radical social changes including a significant re-arrangement of power among established actors. However, policy failure and gaps in the institutional setting can also motivate social innovation (Zivojinovic et al., 2019).

To summarise, social innovations have the potential to contribute to various policy goals and social well-being, however, there is still room to manoeuvre for political support and improvement in practice. Social innovation contains inherently radical transformative elements and goes beyond economic benefits of innovation (Hämäläinen and Heiskala, 2007; Lukesch et al., 2020). Political support must take into account that social innovation is not market-based and also not (merely) profit-oriented but its effects can have high impact on the well-being and welfare of rural areas. Support for network and coordination activities should be intensified by including multi-actor approaches. For future research activities, this requires enhanced empirical research on patterns of involvement across sectors in order to inform policy and practice.

6. Conclusions – concepts, trends and gaps

Although numerous innovation studies talk of innovation governance, this is not a well-defined field or approach and in practice, multiple models or approaches are applied, often developed in heuristic rather than theoretically based ways. In many studies, governance is used rather vaguely as a term without applying specific models or analytical concepts. That being our first observation, in section 2 we provide a possible comprehensive definition of innovation governance. Doing this, we certainly do not call for a single unified approach, although a systematic review and structuring of the field with an overview of approaches would be a worthwhile undertaking. Some of the elements used in this exploratory essay may be used, e.g., distinguishing between organizational/managerial, policy or innovation analysis

studies. For the forestry sector, specifically, we suggest to distinguish between (i) studies focusing on the governance for an innovative provision of specific ways of forest management, goods or services, and (ii) those focusing on innovation processes as such. Furthermore, (iii) specific directional approaches may be distinguished when the governance of innovations is related to additional goals such as sustainability, regional development, or social or economic transformation or transition towards a bioeconomy.

Although a specific understanding of innovation governance is often lacking so far, the broad range of approaches produces highly interesting insights. Notwithstanding the above critique, the multiple approaches applied in the studies is a positive observation and we can state that newest developments from innovation research have also been applied in the field (cp. the literature review, Weiss et al., 2020), and, we may allow ourselves to say, in this Special Issue. Those include a range of approaches that do consider current societal changes and the manifold roles of societal actors or groups, including various stakeholders such as civil society organizations or the (potential) users of the sector's products. They also include innovative forms of sector governance approaches such as public-private partnership or participatory governance and sustainable transformation studies. Less focus has been given to the role of financing and/or financiers.

In general, we can say that, while the applied theories are up-to-date, there is a tendency to adhere to few tried and tested general approaches; more specific, younger or more sophisticated approaches are more rarely applied (Weiss et al., 2020). While this makes for more comparable research results, a greater diversity would benefit the process of generating new insights (Goertz and Mahoney, 2012). Furthermore, most studies are single case studies and/or restricted to a single country. Systematic comparative analyses across countries or sectors would strengthen the field's ability to generate reliable generalizations (Schneider and Wagemann, 2012). In particular, comparisons across different economic, institutional, political, social and cultural settings would allow inferences on the role of contextual factors in innovation (Yildiz et al., 2021).

Accordingly, we see a strong potential to strengthen analytical methods. The selection of empirical material is in fact often based on research funds availability, collaboration opportunities among researchers and/or firms or other instrumental factors. A more purposive selection of datasets and case studies would advance both quality and scope of our research (Etikan et al., 2016). Furthermore, we would want to see more refined qualitative methods in the analysis of case studies and interview data, and more advanced quantitative methods in the analysis of datasets. Methods such as longitudinal analyses or experimental designs are almost entirely lacking in the field. These deficiencies should be seen as research opportunities for scholars willing and able to advance the frontiers of our knowledge of or innovation research linked to the forest sector.

This being said, we may go even further and ask how far research in the forest sector has advanced research in the field of innovation governance? Is the sector just a case study among others, an application of concepts from innovation research, or are we able to bring something back? We have not studied to what extent forest sector research is cited by scholars from other fields, but we see that forest sector cases have been studied by non-sector innovation researchers or published in non-sector journals. Forestry cases have been used in various approaches such as technology studies (e.g., Collins, 1998; MacDonald and Clow, 2010; Watanabe et al., 2018), development studies (e.g., Tewari and Isemonger, 1998; MacQueen et al., 2018), or the study of rural or regional development (e.g., Tödtling and Sedlacek, 1997; de Fátima Ferreira and Sousa, 2019).

Being based on natural resources the forest sector is relevant for innovation and sustainable management (e.g., Winn and Zietsma, 2004; Zhang et al., 2014) and some studies specifically emphasize the ecological or resource dimension in innovation (e.g., Bélis-Bergouignan and Levy, 2010; Aumeeruddy-Thomas et al., 2012). In relation to the

connected value chains, studies discuss, for instance, sustainable energy systems (e.g., Gustavsson et al., 2005; Cavicchi et al., 2017), wood construction (e.g., Rohrer, 2001; Hurmekoski et al., 2015; Hynynen, 2016) or carbon markets (e.g., Carton and Andersson, 2017). In our view, those fields illustrate the high relevance of the forest sector for society and could play an even stronger role in the scientific knowledge in many areas, including and not being restricted to sustainability issues. Considering the dependence of the sector on natural resources it seems surprising that this is rarely put in the center of attention. We should expect the forest sector to make significant contributions to advancing the field of eco- or sustainable innovations (Rennings, 2000; Carayannis and Campbell, 2010) or sustainability transition/transformation (Altenburg and Pegels, 2012).

Researchers from the sector could have the assertiveness that this sector has much to contribute to society and should have the ambition to be able to advance science beyond mere sectoral boundaries. The two emerging fields described in this article have a specific potential to bring forest examples and forest-based research (again) into the center of attention and, as has been shown, this opportunity has already been embraced. The forest sector forms an important part of a bioeconomy and makes important contributions to research (e.g., Birch et al., 2010; Grundel and Dahlström, 2016; Giurca and Metz, 2018; Purkus et al., 2018; DeBoer et al., 2020; Hedeler et al., 2020). We must note that bioeconomy research itself is a new field and still in an initial stage of development with weaknesses such as a lacking integration of the relevant research fields and elements along the value chains as well as a domination of a few countries and research organizations (Lovrić et al., 2020). From our own review, we may specify that the necessary research fields should include, in addition to the “bio” and “economy” fields, also governance, policy, social and institutional studies. Within economics, approaches to enrich our understanding of transformational change include value-based approaches such as a service-dominant logic in marketing and innovation or the role of financing, commercialization and stakeholder power.

Forestry also has manifold possibilities for social innovations, related to rural development contributions (Hewitt et al., 2019; Rogelja et al., 2018), social inclusion (Refsgaard et al., 2017; Ludvig et al., 2018b), ecologically oriented land management (Melnykovych et al., 2018) or participation (Sarkki et al., 2019). A still largely neglected aspect is the role of gender which may have implications or impacts at any stage of production and innovation, from the input and innovators side until the users and societal side (Gladwin et al., 2002; Muneer and Mohamed, 2003; Hansen et al., 2016; Martini et al., 2017; MacQueen et al., 2018).

The literature contains many critiques of the industry as being non-innovative and lacking the culture necessary to successfully innovate. There is, however, little work documenting how some firms have successfully shifted their culture and increased their innovation success. Work is also needed to identify the tweaks needed in the overall sectoral innovation systems that would re-engage forest sector firms in modern innovation management techniques and processes, and help to break free from sectoral siloes. The potential roles of moderators or mediators, openness to outside sectors, company climate, entrepreneurial (and intrapreneurial) orientation, creative milieus or user orientation could make contributions here.

There is a clear need for continued research, such as Näyhä (2020), to understand the evolving strategies and operations of forest sector firms, and especially how the private sector can contribute to sustainability transition at global and local levels. The changing industry structures will also reflect in defining sustainability priorities, and more systemic thinking and interplay of different sized companies within innovation and business ecosystems is needed. Bridging the gap between bioeconomy and circular economy driven narratives is also called for, and clearer views on what kind of transition, what kind of sustainability, or what kind of bioeconomy (Bugge et al., 2016; Hausknost et al., 2017).

Finally, even when insightful research is conducted and published, it is unclear whether these findings are impacting the thinking of industry

managers. This missing link in the innovation system should be further addressed by the academy.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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